CONTROLLING THE INDIAN MEAL MOTH IN SHELLED CORN WITH DICHLORVOS PVC RESIN STRIPS

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Controlling the Indian Meal Moth in Shelled Corn with Dichlorvos PVC Resin Strips

By

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SUMMARY

Polyvinyl chloride (PVC) strips impregnated with dichlorvos gave excellent control of adult Indian meal moths *Plodia Interpunctella* (Hübner) during 24-hour exposures to the vapors from a dosage of one strip per 1,000 cubic feet of overspace. Moths exposed in the test bins were able to deposit fertile eggs before being killed and a few F_1 larvae developed, but the F_1 adults were killed upon emergence before mating was accomplished.

In corn containing an active infestation before the strips were installed, larval webbing protected the immature and adult forms from the vapors, and the indigenous infestation was maintained. Adults were killed when the webbing was removed.

The dichlorvos vapors were not effective against fourth- and fifth-instar larvae confined within the surface 2 inches of corn, but some mortality occurred there among second- and third-instar larvae.

The vapors killed a few of the pupae exposed in the overspace and on the grain surface, but most of the insects were not killed until they emerged as adults. Pupae located 0 to 4 inches below the grain surface were only slightly affected.

The treatment had a slightly adverse effect on the viability of eggs dropped on the surface corn and confined 0 to 2 inches deep, but many larvae developed to maturity and emerged as normal adults. Eggs confined 2 to 4 inches deep were not affected.

An average of about 0.2 p.p.m. dichlorvos residue was maintained on the surface 0 to 2 inches of corn during the first 8 weeks of storage; thereafter, a gradual decline occurred until less than 0.1 p.p.m. residue remained on the samples taken at the end of an 18-week storage period.

INTRODUCTION

Control of the Indian meal moth, *Plodia interpunctella* (Hübner), and other lepidopterous insects in stored grain was achieved in the past with aerosol fogs or surface sprays containing pyrethrins plus piperonyl butoxide, or with malathion. The synergized pyrethrins treatments were more expensive than malathion treatments. Control often failed because the treatments were not made frequently enough, or because high operating costs resulted in insufficient quantities being applied. Furthermore, applications were not always made at the proper time. As a result, malathion came to be more generally used on stored grain. However, malathion is no longer completely effective because the Indian meal moth has developed a resistance to this pesticide. Damaging infestations have been found in corn containing as much as 81 p.p.m. malathion residue.[2] As a control, fumigation is expensive, time-consuming, and does not provide lasting protection.

Satisfactory substitutes for malathion may be found, but usually the hazard of unwanted chemical residues exists. One substitute, dichlorvos (2,2-dichlorovinyl dimethyl phosphate), has a high initial toxicity for many insects and residues that are short lived. In vapor form, it has been effective against a variety of stored-product insects, including the cigarette beetle, *Lasioderma serricorne* (Fabricius)[3]; *Drosophila melanogaster* Meigen[4]; the tobacco moth, *Ephestia elutella* (Hübner)[5]; the Mediterranean flour moth, *Anagasta*

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[2]La Hue, D. W. Control of malathion-resistant Indian-meal moths *Plodia interpunctella* (Hübner) with dichlorvos resin strips. No. Cent. Branch Ent. Soc. Amer. Proc. 24(2): 117-119. 1969.

[3]Tenhet, J. N., Bare, C. O., Childs, D. P., and Durnam, W. F. Studies of DDVP for control of cigarette beetles in tobacco warehouses. U.S. Dept. Agr., Agr. Market. Serv. AMS 214, 15 pp. 1957.

[4]Jay, Edward G., Harein, P. K., and Gillenwater, H. B. The toxicity of dichlorvos in air to adult *Drosophila melanogaster*. Jour. Econ. Ent. 57(3): 413. 1964.

[5]Green, A. A., Kane, Joyce, and Gradidge, J. M. G. Experiments on the control of *Ephestia elutella* (Hb.) (Lepidoptera, Phycitidae) using dichlorvos vapour. Jour. Stored Prod. Res. 2(2): 147-157. 1966.

kuehniella (Zeller)[6]; and the almond moth, *Cadra cautella* (Walker).[7]

The dichlorvos-impregnated polyvinyl chloride (PVC) resin strip used in the study was perfected to fill the need for a relatively cheap formulation that would provide a slow, continuous release of the vapors. The formulation requires neither specialized equipment nor skilled labor for application.

The study was made to determine the effectiveness of the PVC strip as a device for applying dichlorvos in vapor form to control Indian meal moth infestations, and to investigate the extent of the dichlorvos residues deposited on the surface of the stored corn. The three experiments consisted of preliminary laboratory, small-bin, and simulated large-bin tests.

MATERIALS AND METHODS

The tests were conducted in laboratory rooms at temperatures ranging from 68° to 85° F. and 45- to 62-percent relative humidity. Shelled corn containing about 12.5-percent moisture, 2.2-percent foreign material, and 3.6-percent cracked kernels was used. All insect exposures were replicated at least four times.

The slow-release PVC strips were installed at a dosage equivalent to one strip per 1,000 cubic feet of overspace in all tests except the preliminary tests conducted to determine dosage requirements. The strips, which are about 10 inches long by 2 1/2 inches wide by 1/4 inch thick, contain 18.6 percent dichlorvos and 1.4 percent related compounds.

PRELIMINARY LABORATORY EXPERIMENTS

The preliminary tests were conducted with 8,000-gram lots of corn in plastic tubs. The Indian meal moths were exposed to the dichlorvos vapors emitted by weighed portions of the strips. Tubs filled with corn were used as individual units under conical covers for small-lot tests and other tubs were exposed to the vapors in an insect-rearing room for small-room tests. These tests were conducted at 80° F. and 60-percent relative humidity. Installations of weighed portions of strips at dosage rates of 1/2, 3/4, 1, 1 1/2, and 2 strips per 1,000 cubic feet of overspace were tested under individual covers to determine the mortality of adult moths with different periods of exposure to the vapors. Following these tests, the dosages appearing most promising were used in replicated tests conducted in small rooms. The results obtained during the preliminary tests were used to establish the dosage and handling techniques for subsequent tests conducted in small bins and in simulated large bins.

SMALL-BIN EXPERIMENTS

Fifty-pound lots of shelled corn in 5-cubic-foot bins were exposed for 16 weeks to dichlorvos vapors from strip portions. Adult moths confined in screen cages were subjected to the vapors for 24-hour periods in the overspace; on the corn surface; and 1, 2, and 4 inches below the surface. Eggs were exposed 0 to 2 inches and 2 to 4 inches deep in the corn. Other bins containing corn heavily infested with the Indian meal moths in all stages before strip installation were compared with bins of uninfested corn into which adult moth introductions were made during the first 8 weeks after strip installation. Bins containing corn of both conditions but not exposed to the vapors were maintained as untreated checks. The temperature of the air surrounding the small bins ranged from 72° to 80° F. with a range in relative humidity of 47 to 54 percent.

SIMULATED LARGE-BIN EXPERIMENTS

Cylindrical bins constructed with one-eighth-inch masonite walls and 6-mil clear plastic conical roofs were used to simulate surface and overspace conditions found in 3,250-bushel metal storage bins (fig. 1). These simulated large bins were 7 feet 5 inches in diameter and had 4-foot-high walls and 1.5-foot conical roof elevations. Aeration slots were installed at the eaves to simulate the openings found at the junction of the wall and roof in large metal bins. An access door was installed in the wall of each bin. Indian meal moth adults, eggs, larvae, and pupae were exposed periodically during the 18-week study to dichlorvos vapors emitted by the strips or to residues on the corn deposited by the dichlorvos vapors. A full complement of checks were maintained in bins without strip installations.

Screen cages containing 2- to 4-day-old moths were suspended at different locations in the overspace, placed on the surface, and buried in the corn. Immature larval forms in cages were confined 0 to 2 inches below the corn surface. Pupae were exposed in screen cages

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[6]Conway, J. The control of *Anagasta Kuehniella* (Zeller) (Lepidoptera, Phycitidae) in bulk meal bins using dichlorvos slow release PVC strips. Jour. Stored Prod. Res. 1(4): 381-383. 1966.

[7]La Hue, D. W. Unpublished data.

Figure 1.–Experimental storage bin, showing entrance door and plastic roof, simulates 3,250-bushel metal bin.

suspended in the overspace, on the surface of the corn, and 0 to 2 inches and 2 to 4 inches below the surface. Eggs were dropped on the corn for depth placements of 0 to 2 inches and 2 to 4 inches below the surface.

Samples of corn were periodically taken 0 to 2 inches and 2 to 4 inches below the surface, and were then analyzed by a standard method for total dichlorvos content.

RESULTS

PRELIMINARY LABORATORY EXPERIMENTS

Dosages of 1, 1 1/2, and 2 strips per 1,000 cubic feet consistently killed adult moths exposed for 24 hours (table 1). Dosages of three-quarters of a strip or less gave inconsistent kills. In a follow-up-room (small-room) test conducted for 6 weeks, a dosage of one PVC strip per 1,000 cubic feet of overspace killed all moths in the overspace during exposure for 24 hours (table 2). In this test, moths emerging into cages on the surface of corn with an indigenous infestation were all killed within 24 hours.

Moths under larval webbing were not killed by the one-strip dosage, and viable eggs were found under the webbing. Examinations disclosed that all developmental stages of the Indian meal moth were present under the webs 6 weeks after installation of the strip.

Table 1.–Mortality of caged adult Indian meal moths after exposures to dichlorvos vapors emitted by PVC strips; small-lot tests[1]

Strips (number) per 1,000 cu. ft. of overspace	1 week after strip installation at indicated exposure (hr.)				3 weeks after strip installation at indicated exposure (hr.)			
	12	24	36	48	12	24	36	48
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1/2	56.9	79.6	84.3	82.2	67.3	76.4	75.3	86.0
3/4	76.0	93.0	100.0	97.6	82.5	81.6	87.4	100.0
1	93.2	100.0	100.0	100.0	92.1	100.0	100.0	100.0
1 1/2	91.2	100.0	100.0	100.0	97.6	100.0	100.0	100.0
2	98.1	100.0	100.0	100.0	99.7	100.0	100.0	100.0

[1]Mortality determinations made from 2 separate tests with 5 replications each.

Table 2.—Mortality of caged adult Indian meal moths after exposures to dichlorvos vapors emitted by 1 PVC resin strip per 1,000 cubic feet; small-room test

Period (weeks) after strip installation	Length of exposure (hours)			Unexposed check[1]
	12	24	36	
	Percent	*Percent*	*Percent*	*Percent*
2	86.3	100.0	100.0	0
3	91.2	100.0	100.0	0
4	94.1	100.0	100.0	0
5	86.3	100.0	100.0	2.0
6	90.1	100.0	100.0	0

[1] After 36 hours.

SMALL-BIN EXPERIMENTS

Infestations of Indian meal moths did not develop from repeated introductions of adult moths to corn protected by the strips or strip portions. Infestations were established in unprotected corn, and damaging infestations were maintained in unexposed check corn with an indigenous population of moths. The numbers of moths in bins with indigenous populations gradually decreased with exposure to the dichlorvos vapors until the infestations were eliminated (tables 3 and 4). All adults in cages in the overspace and on the corn surface were killed by the 24-hour exposures, but many adults survived these exposures in cages placed about 2 inches below the grain surface (table 5).

Complete kills were not obtained in any of the exposures of caged adults made 1 inch, 2 inches, and 4 inches below the corn surface (table 6). F_1 progeny developed in all of the exposed lots except in the 1-inch cage placements made 4 and 8 weeks after strip installation. Very little effect on egg viability was apparent in placements made 0 to 2 inches and 2 to 4 inches below the corn surface (table 7).

Table 3.—Populations of adult Indian meal moths, resting and flying or dead, after exposures to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet of overspace; small-bin tests

Period (weeks) after strip installation	Exposed to vapors while in corn and in overspace				Untreated check			
	Indigenous infestation		Introduced infestation[1]		Indigenous infestation		Introduced infestation[1]	
	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
1	27.0	15.6	0	3.2	21.0	3.0	6.2	1.0
2	33.2	6.6	0	4.6	26.2	7.0	11.0	3.0
3	46.2	9.2	0	4.0	34.2	2.4	15.0	0
4	38.6	18.0	0	3.2	39.0	3.4	19.2	0
5	43.2	11.0	0	5.4	30.0	4.0	14.8	2.0
6	28.4	7.2	0	5.8	42.4	1.8	17.4	1.2
7	17.8	7.8	1.0	2.2	27.8	8.2	29.4	0
8	9.2	6.0	0	1.0	31.0	6.6	47.6	5.0
9	4.0	3.2	0	0	[3] 16.6	9.6	52.0	3.2
10	3.0	2.2	0	1.0	[3] 28.0	3.4	42.2	4.0
12	0	1.0	1.2	4.0	[3] 30.2	3.0	[3] 28.8	7.4
14	0	0	0	0	[3] 32.8	2.0	[3] 31.0	5.8
16	1.0	.2	0	0	[3] 24.2	4.2	[3] 30.2	5.0
18[4]	0	0	0	0	[3] 20.0	4.2	[3] 22.0	6.0

[1] Counts made 72 hours after adult introductions of 20 moths per square foot of surface corn; introductions made at 7-day intervals from the 1st to 8th week.

[2] Dead moths collected on 2 carboard plates with 7-inch diameters.

[3] Diseased larvae noted on surface.

[4] Strips were removed at end of 16th week, but counts were continued until end of 18th week.

Table 4.—Populations of live Indian meal moth larvae and pupae, 0 to 4 inches below the surface of shelled corn exposed to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet; small-bin tests

Period (weeks) after strip installation	Exposed to vapors		Untreated check	
	Indigenous infestation	Introduced infestation	Indigenous infestation	Introduced infestation
	Number	*Number*	*Number*	*Number*
0[1]	16.0	0	14.4	0
10	7.2	.2	17.8	4.8
12	3.0	2.0	26.0	12.2
14	.2	0	[2] 18.8	[2] 14.6
16	0	0	[2] 10.6	[2] 15.6
18[3]	0	0	[2] 16.2	[2] 21.2

[1]Count made at beginning of test. All counts were made of larvae and pupae contained in 1-pint samples.
[2]Diseased larvae noted.
[3]Strips were removed at end of 16th week, but counts were continued until end of 18th week.

Table 5.—Mortality of caged adult Indian meal moths exposed for 24 hours to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet of overspace; small-bin tests

Period (weeks) after strip installation	Exposed to vapors while—			Untreated check[1]		
	Suspended in overspace	On surface	0 to 2 inches below surface	Suspended in overspace	On surface	0 to 2 inches below surface
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1	100.0	100.0	[2] 78.0	0	0.5	0
2	100.0	100.0	86.0	2.0	1.0	1.2
4	100.0	100.0	[2] 78.9	1.2	0	0
8	100.0	100.0	[2] 70.0	1.0	0	0
10	100.0	100.0	[2] 68.9	0	2.5	0
12	100.0	100.0	[2] 64.5	.5	2.4	2.2
16	100.0	100.0	[2] 52.8	.4	0	1.2
18[3]	[2] 2.0	[2] 24.0	[2] 29.5	0	1.0	.5

[1]F_1 progeny developed from these placements.
[2]F_1 progeny developed from this exposure.
[3]Strips were removed at end of 16th week, but counts were continued until end of 18th week.

Table 6.—Mortality of caged adult Indian meal moths[1] exposed for 24 hours to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet; small-bin tests

Period (weeks) after strip installation	Exposed to vapors[2] while—			Untreated check
	1 inch below surface	2 inches below surface	4 inches below surface	
	Percent	*Percent*	*Percent*	*Percent*
4	90.6	[3] 76.8	[3] 24.0	[3] 2.0
8	96.4	[3] 70.0	[3] 21.4	[3] 0
12	[3] 85.5	[3] 68.2	[3] 19.8	[3] 0
16	[3] 71.6	[3] 50.8	[3] 8.3	[3] 2.0

[1]Adults confined in 1-inch-diameter by 3-inch-long screen cages partially filled with corn lightly dusted with cornmeal.
[2]About 50 adults (10 adults per cage) were placed at 5 locations for each 24-hour exposure period.
[3]F_1 progeny developed from this exposure.

Table 7.—Viability of Indian meal moth eggs in shelled corn exposed to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet of overspace; small-bin tests

Period (weeks) after strip installation	Exposed to vapors[1] while—		Untreated check
	0 to 2 inches below surface	2 to 4 inches below surface	
	Percent	*Percent*	*Percent*
4	71.6	82.1	81.7
5	70.7	–	84.5
7	77.3	86.4	87.6
9	70.0	86.9	86.2
11	74.2	–	81.9
12	–	81.1	82.8
14	78.5	83.9	79.3
16	77.8	79.8	78.4

[1] About 500 eggs (100 eggs per carton) were placed at 5 locations for each 5-day exposure period.

SIMULATED LARGE-BIN EXPERIMENTS

Adults confined in cages in the overspace and on the surface of the corn were all killed by the dichlorvos vapors during 24-hour exposures, but some of the adults in cages 0 to 2 inches below the surface survived to deposit fertile eggs (table 8). All of the F_1 adults which developed from the exposures made below the surface were killed after emergence and before mating.

Table 8.—Mortality of caged adult Indian meal moths exposed for 24 hours to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet of overspace; simulated large bin tests

Period after strip installation	Exposed to vapors while—			Untreated check[1]
	Suspended in overspace	On surface	0 to 2 inches below surface	
Days:	*Percent*	*Percent*	*Percent*	*Percent*
1	100.0	100.0	[2] 84.4	1.2
2	100.0	100.0	[2] 89.8	0
3	100.0	100.0	98.9	5.0
4	100.0	100.0	100.0	2.6
Weeks:				
1	100.0	100.0	96.0	3.2
3	100.0	100.0	100.0	2.0
5	100.0	100.0	100.0	5.0
7	100.0	100.0	98.9	0
9	100.0	100.0	[2] 97.9	0
12	100.0	100.0	[2] 86.9	2.1
14	100.0	100.0	[2] 79.8	1.2
16	100.0	100.0	[2] 75.3	1.8
18	100.0	98.9	[2] 65.0	0

[1] F_1 progeny developed from these placements.
[2] F_1 progeny developed from this exposure.

The dichlorvos vapors did not affect the viability of eggs placed 2 to 4 inches below the suface, but the hatch was slightly reduced in the 0- to 2-inch placements (table 9).

The dichlorvos vapors had very little effect on large feeding larvae (4th and 5th instar) confined in cages to the top 2 inches of the corn for 7 days (table 10). In 14-day exposures of caged small larvae (2d and 3d instar), the mortality ranged from 26.4 to 39.4 percent. This mortality range compared with a range of 16.4 to 24.7 percent of small larvae in unexposed checks (table 11).

Many of the naked pupae exposed in the overspace and on the surface of the corn were killed by the dichlorvos vapors, but those within the corn were only slightly affected (table 12). All adults that emerged in the overspace and on the surface were killed by the vapors without depositing eggs. F_1 progeny larvae were recovered from most of the corn samples in which the insects were exposed as pupae at 0 to 2 and 2 to 4 inches below the surface.

Table 9.—Viability of Indian meal moth eggs in corn exposed to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet; simulated large-bin tests

Period (weeks) after strip installation	Exposed to vapors[1] while—		Untreated check
	0 to 2 inches below surface	2 to 4 inches below surface	
	Percent	*Percent*	*Percent*
6	69.4	83.7	81.2
8	70.0	80.1	82.0
10	71.9	81.4	79.1
12	76.3	79.6	78.6

[1]About 500 eggs (100 eggs per carton) were placed at 5 locations for each 5-day exposure period.

Table 10.—Mortality and survival of 4th- and 5th-instar Indian meal moth larvae, 0 to 2 inches below the surface of shelled corn exposed to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet; simulated large-bin tests

Period (weeks) after strip installation	Exposed to vapors[1]				Untreated check[1]			
	Larvae (dead)	Pupae (live)	Emergent adults	Diapausing immatures[2]	Larvae (dead)	Paupae (live)	Emergent adults	Diapausing immatures[2]
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
4	9.6	69.2	67.3	21.2	0	72.0	72.0	28.0
6	12.5	55.4	53.6	32.1	3.7	70.4	68.5	29.6
8	17.5	49.2	46.0	33.3	5.5	70.9	67.3	29.1
10	8.2	69.4	65.3	22.4	0	73.2	71.4	26.8
12	9.4	30.2	30.2	60.4	1.8	47.4	47.4	52.6
14	5.9	37.3	37.3	56.9	0	58.0	58.0	42.0
16	7.3	40.0	38.2	52.7	0	60.8	56.9	39.2

[1]Caged larvae confined in corn bins for 7 days.
[2]Number of immatures surviving 7 days after removal from bins.

Table 11.–Mortality of caged 2d- and 3d-instar larvae of the Indian meal moth, 0 to 2 inches below the surface of shelled corn exposed to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet; simulated large-bin tests

Period (weeks) after strip installation	Mortality of larvae[1]	
	Exposed to vapors	Untreated check
	Percent	*Percent*
5	39.4	24.7
7	29.6	19.1
11	30.1	21.3
13	26.4	16.4

[1] Based on number of larvae surviving after 14-day test period.

Table 12.–Emergence of adult Indian meal moths from naked 3- to 4-day-old pupae exposed in cages to dichlorvos vapors emitted by 1 PVC strip per 1,000 cubic feet of overspace; simulated large-bin tests

Period (weeks) after strip installation	Exposed to vapors				Untreated check[1]
	Suspended in overspace	On surface	0 to 2 inches below surface	2 to 4 inches below surface	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
8	69.0	72.0	93.0	[2] 99.0	100.0
10	74.0	70.0	95.0	--	99.0
12	80.0	86.0	[2] 90.0	[2] 100.0	100.0
14	79.0	83.0	[2] 96.0	--	98.0
16	85.0	90.0	[2] 92.0	[2] 100.0	100.0

[1] F_1 progeny recovered from these placements.
[2] F_1 progeny larvae recovered from cages containing corn lightly dusted with cornmeal.

DICHLORVOS RESIDUES

Residues of 0.2 and 0.3 p.p.m. were recorded in corn samples 0 to 2 inches deep taken after 3 weeks' exposure to the vapors emitted by the strips (table 13). An average residue of about 0.2 p.p.m. was maintained on these samples for nearly 9 weeks; thereafter, a slight decline was indicated. Residues on corn 2 to 4 inches below the surface averaged less than 0.1 p.p.m.

Table 13.–Dichlorvos residues in stored shelled corn exposed to vapors from 1 PVC strip per 1,000 cubic feet of overspace; simulated large-bin tests

Depth of sample and replication No.	Storage period after strip installation										
	72 hours	1 week	3 weeks	5 weeks	7 weeks	9 weeks	11 weeks	13 weeks	15 weeks	17 weeks	18 weeks
0 to 2 inches:	*P.p.m.*	*P.p.m*	*P.p.m*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*
1st replication	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.2	< 0.1	< 0.1	< 0.1
2d replication	.1	.1	.3	.2	.2	.1	.1	.2	< .1	.1	.1
3d replication	.1	.2	.3	.2	.2	.1	.1	.1	< .1	.1	.1
2 to 4 inches:											
1st replication	< .1	< .1	.1	.1	< .1	< .1	< .1	< .1	< .1	< .1	< .1
2d replication	< .1	.1	.1	.1	.1	.1	.1	< .1	< .1	.1	.1
3d replication	< .1	< .1	.1	.1	.1	.1	.1	< .1	< .1	.1	.1

CONCLUSIONS

The preliminary studies show that Indian meal moth adults can be satisfactorily controlled by 24-hour exposures to the dichlorvos vapors emitted by slow-release PVC strips. Even though the dichlorvos vapors tested in this study had a relatively rapid action, premated females survived long enough to deposit fertile eggs. Mating pairs of moths were noted in small bins of corn containing indigenous populations subjected to the strips, but the populations were gradually reduced.

Webbing on the surface of the corn protected immature and adult insect forms, and the infestations were continued unless the webbing was removed. Large larvae and pupae were not readily killed by the vapors; however, adults that emerged and were held in the overspace were killed before they deposited fertile eggs. Eggs deposited in the surface corn hatched, and many small larvae escaped the killing action of the dichlorvos vapors. However, eggs remaining exposed on the surface were somewhat affected, and many of the small larvae were killed before entering the corn mass.

The results of these experiments indicate that PVC strips may be effectively used as a control of flying lepidopterous insects in grain storages, but further studies with the strips should be conducted to determine the effects of different temperature and moisture conditions.

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